Meteorological records at Anatolia College, Merzifoun, Asia Minor.

1903.	Air pressure (in millimeters).					Air temperature (in degrees centigrade).										
	Average.	Maximum.	Date.	Minimum.	Date.	7 a. m.	1:45 p. m.	9 p. m.	Average.*	Average maxima.	Average minima.	Average daily range.	Absolute maximum.	Date.	Absolute minimum.	Date.
January	694.97	699.3	25	687.7	15	— 3.6	6.5	2.8	2.38	1.47	— 3.93	5.40	8.5	14	—13.5	26
February	695.5	703.5	26	686.2	16	— 5.95	2.89	0.96	— 1.14	3.9	— 3.4	7.3	10	24	—10.5	20
March	693	699.2	28	685	7	1.70	8.41	3.66	4.3	9.47	0.32	9.15	19.5	31	— 3.5	17
April	688.5	694.7	4	684.7	7	10.25	16.4	10.45	11.8	18.18	6.25	11.93	24	19	1.5	4
May	690.9	695.8	15	686.5	25	14.93	18.9	13.1	15	20.9	9.34	11.56	30	14	5.5	19
June	688.7	692.9	4	682.4	23	18.25	21.4	15.5	17.6	23.5	12.1	11.4	28	28	9.5	7
July	690.1	694	15	685.3	22	19.3	22.8	17.3	19.1	24.30	13.42	10.88	30	9	9	6
August	690.3	695	6	682.8	18	17.6	22.5	16.8	18.4	23.5	13.5	10	30.5	18	9.5	20
September	693.8	698.1	5	688.5	11	13.1	18.4	12.8	14.3	19.2	8.9	10.3	28	16	2.5	28
October	692.5	697.2	15	685	11	8.92	15.9	11.5	11.9	16.6	6.9	9.7	23	8	1	23
November	693.9	699.7	2	684.4	23	2.9	8.15	4.8	5.2	8.6	2.2	6.4	14	22	— 4.5	27
December	693.4	700.3	22	685.5	9	2	6	3.1	3.5	6.5	1.3	5.2	11.5	11	— 3	5
Annual	693.8	697.5	......	685.5	......	8.28	14.02	9.4	10.3	14.68	5.57	9.11	30.5	......	—13.5	......

1903.	Cloudiness, 0-10.						Precipitation.					Wind, number of observations with—								
	7 a. m.	1:45 p. m.	9 p. m.	Average.	Clear days (less than 2).	Cloudy days (more than 8).	Total.	Maximum.	Date.	Days with 1 mm.	Days with more than 2 mm.	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm.
January	6.8	6.7	5.4	6.3	8	15	20.2	5	18	2	5	1	40	8	1	3	3	3	5	29
February	4.8	5.2	4.1	4.9	8	7	7.9	2.2	23	4	1	3	35	4	0	2	7	4	6	23
March	4.7	5.4	3.8	4.6	11	8	35.2	13	12	5	3	2	40	3	5	0	8	0	1	34
April	4.1	5.4	4.3	4.6	8	4	29.7	8 .7	26	4	5	3	21	2	8	2	13	4	2	35
May	4	6.2	5.3	5.2	5	9	87.1	19.8	6	4	8	4	29	1	1	0	9	0	4	45
June	4.3	5.5	4.6	4.8	6	5	95.1	24.4	14	6	10	3	31	3	2	0	14	0	1	36
July	3.9	3.8	1.9	3.2	14	3	25.2	6	6	1	5	22	32	4	0	0	2	1	0	32
August	4.4	3.8	2.6	3.6	12	3	73.3	25.6	6	1	5	23	21	1	0	0	1	1	0	46
September	3.6	2.1	2.8	2.8	15	1	10.7	10.7	11	0	1	13	29	0	0	1	0	0	1	46
October	3.4	3.6	3	3.3	17	3	33.7	20	31	1	3	15	4	0	0	0	2	0	0	72
November	6.6	6.7	5.4	6.2	4	11	38.8	14.8	14	1	5	13	2	0	0	0	0	0	0	75
December	8.1	9.2	7.5	8.2	1	20	25.1	7	31	3	4	2	0	0	1	0	0	0	1	89
Annual	4.9	5.3	4.2	4.8	109	89	482.0	....	......	32	54	104	284	26	18	8	59	13	21	562

NOTE.—The decimals are printed as in the original manuscript. Unfortunately, the total number of rainy days is not given. *1/3 (7 a. m. + 1.45 p. m. + 9 p. m.).

REMARKS ON BIGELOW'S STUDIES ON THE CIRCULATION OF THE ATMOSPHERE.

By Prof. A. WOEIKOF, dated St. Petersburg, Russia, March 1, 1904.

The best means to detect an influence of a change of solar radiation on the temperature of the atmosphere would be the difference of pressure between tropical heights and the lowlands at their base, as has been shown by Hann. The pressure differences would depend not only on the temperature of the whole air stratum between the pairs of stations, but also on the quantity of vapor, for as the Tropics have a great percentage of water surface a larger evaporation would result from a greater quantity of solar heat, and the effect on the temperature of the lower stratum would be marked in some cases by increased cloud and rain. Unfortunately there are few mountain or even plateau stations of the Tropics with long records. India and Ceylon would alone be available, but in that region there are stations covering the years 1873-1900 which Professor Bigelow uses. For a shorter period nearer to our time the stations in Peru and Hawaii would be available. As the tropical high stations are few and their importance is great, it would be worth while to make all the calculations necessary to give a true mean; the reduction of different hours of observation is facilitated by the very great steadiness of the daily variations of pressure in the Tropics, so that the reduction factor from hourly observations in the lowlands could be used, taking into account the diminution of pressure with altitude. I hope these remarks will not be taken as a disparagement of the excellent work of Professor Bigelow, but simply as a suggestion for a future extension.

THE VERTICAL COMPONENT OF THE WIND.

By Rev. MARC DECHEVRENS, S. J., Director of the Observatory of St. Louis, island of Jersey, England, dated March 1, 1904.

In the MONTHLY WEATHER REVIEW for November, 1903, page 536, there is an interesting note in which the Editor speaks of the vertical component of the movements of the atmosphere. It concludes with the following remarks:

It is very desirable that we should have both demonstrations and measurements of the rate of ascent and descent of currents of air. * * * Any contribution to the subject of the vertical component of atmospheric motions will be welcome to the meteorologist.

Previously, in the Editor's "Treatise on meteorological apparatus and methods," in 1887, he described an inclinometer of my invention, intended to measure the angle of the wind with the horizon, but said nothing of the anemometer with which, in 1887, I replaced this very defective vane. This anemometer fulfils the wish which he expressed to see an anemometer of rotation substituted for the vane.

I put it in operation at the Observatory of Zi-Ka-Wei, China, in 1896 and 1897. After my return to Europe I installed it in 1894 at Jersey, under conditions according well with those which the Editor demanded, in 1887, to ensure observations of real utility:

Only in a level country or at sea, with a vane (or better an anemometer of rotation) established upon a very high tower, can we feel assured that the results of vertical measurements will be of meteorological importance, and that general currents, vertical or inclined, are really the subject of observation.

Jersey is a rather small, level island at the mouth of the English Channel, and the steel tower, of which I send a photograph, fig. 1, intended for the exposure of the anemometers, was erected on a hill of 55 meters, near the shore; it is, itself, 50 meters high, and the anemometer rises above it 6 meters, so that the total elevation of the anemometer is 111 meters.

Besides the picture of the tower I send also one of the Dechevrens universal anemometer, fig. 2. I had conceived the idea of it in China, and succeeded in having it constructed by the firm of Richard, at Paris. It analyzes the movement of the air in the same manner that a complete magnetograph analyzes the magnetic condition of the earth; it measures at the same time the direction of the wind and the two components, horizontal and vertical, of its velocity. In order to get the horizontal component I have substituted, for the hemispherical cups of Robinson, straight semicylinders, which you will easily distinguish in the picture in the anemometer on the right; it is evident that this anemometer can not feel any effect from the vertical component of the wind. On the other hand, my inclined-blade anemometer, on the left, can not be influenced by the horizontal component, and by means of the mechanism inclosed in the box below, separate electric currents register, without any confusion, both the ascending and descending wind currents, respectively. The direction of the wind, also, is given electrically by the revolution of the two parallel vertical windmill wheels, which are below the horizontal bar carrying the anemometers. These two wind wheels have another object, viz., in revolving with the wind to turn also the horizontal bar with its two anemometers. Thus, the latter always face the wind, and one of them can never screen the wind from the other. This is of great importance in the use of rotary anemometers, and I am persuaded that in a great number of observatories, and particularly at the Eiffel Tower in Paris, the observations of wind velocity obtained with different forms of anemometer are made erroneous by the proximity of other apparatus erected in nearly the same horizontal plane. At Jersey the universal anemometer is alone on the axis of the tower, and its two windmill wheels are always under the same conditions with regard to the direction of the wind.

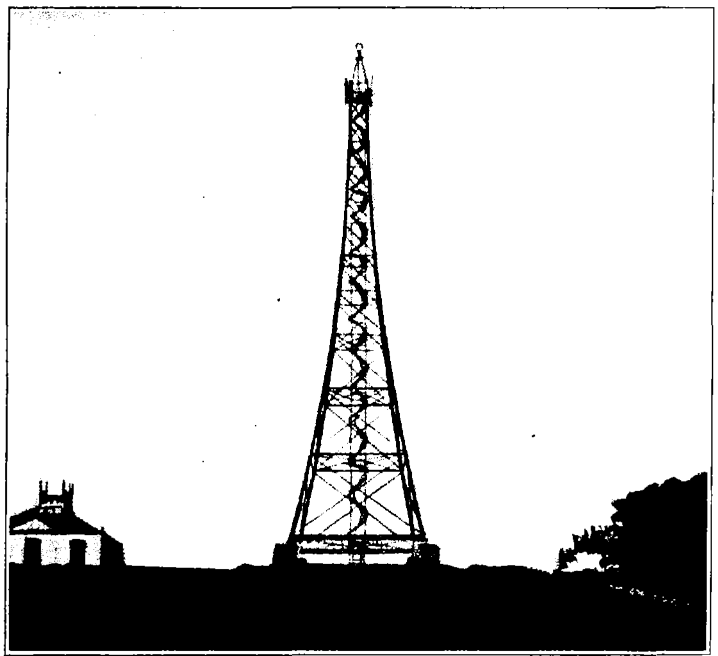

FIG. 1.—Steel tower of the St. Louis Observatory, island of Jersey; 50 meters in height; the anemometer at the summit is 111 meters above sea level.

The observations commenced in the course of the year 1894. The first eight years now form the subject of detailed studies which will be published shortly.

In the meantime, I believe I may do you a service by communicating the general results of two years which I have studied especially with regard to the *descending* component. These results do not differ sensibly from those of the eight years together.

The diurnal variation of the horizontal component of wind velocity at 111 meters above the sea level at Jersey is feeble compared to what it is near the ground and on the Continent. The ratio of the maximum to the minimum is only 1.06.[1] The variation is intermediate between that of the plains and that of the mountains; in the former we have the maximum at noon, in the latter a freshening of the wind in the middle of the night.

[1] That is 25.55/24.13.

Average components of the hourly velocity of the wind at 111 meters altitude on the island of Jersey.

Hours.	October, 1901, to September, 1903.				
	Horizontal component, *H*.	Vertical component.		Ratios.	
		Ascending, *A*.	Descending, *D*.	$\frac{A-D}{H}$	$\frac{D}{A}$
	Kilometers.	*Meters.*	*Meters.*		
Midnight–1 a. m	25.00	2779.2	35.1	0.1098	0.0126
1 a. m.–2 a. m.	24.80	2753.6	34.3	0.1096	0.0125
2 a. m.–3 a. m	24.72	2738.1	34.2	0.1094	0.0125
3 a. m.–4 a. m	24.77	2720.4	32.8	0.1085	0.0121
4 a. m.–5 a. m	24.43	2708.9	34.2	0.1095	0.0126
5 a. m.–6 a. m	24.32	2708.0	37.5	0.1098	0.0138
6 a. m.–7 a. m	24.13	2724.7	48.2	0.1109	0.0177
7 a. m.–8 a. m	24.35	2777.6	63.2	0.1115	0.0227
8 a. m.–9 a. m	24.58	2849.9	82.3	0.1126	0.0288
9 a. m.–10 a. m	24.92	2934.5	101.0	0.1137	0.0344
10 a. m.–11 a. m	25.28	3014.3	117.0	0.1146	0.0388
11 a. m.–Noon	25.46	3075.0	127.5	0.1158	0.0414
Noon–1 p. m	25.55	3113.8	130.8	0.1168	0.0420
1 p. m.–2 p. m	25.49	3119.9	126.3	0.1174	0.0405
2 p. m.–3 p. m	25.40	3097.9	114.7	0.1174	0.0370
3 p. m.–4 p. m	25.26	3039.0	98.5	0.1164	0.0324
4 p. m.–5 p. m	25.09	2965.7	80.8	0.1150	0.0272
5 p. m.–6 p. m	24.99	2880.3	64.0	0.1127	0.0222
6 p. m.–7 p. m	25.00	2822.8	51.3	0.1109	0.0182
7 p. m.–8 p. m	25.07	2783.3	43.8	0.1093	0.0157
8 p. m.–9 p. m	25.17	2779.0	39.5	0.1088	0.0142
9 p. m.–10 p. m	25.26	2781.3	37.8	0.1086	0.0136
10 p. m.–11 p. m	25.34	2791.1	36.4	0.1087	0.0130
11 p. m.–Midnight	25.20	2787.3	36.1	0.1092	0.0130
Mean	24.98	2865.0	67.0	0.1120	0.0234

The total vertical component is far from being negligible, and its variation is very regular; it is manifestly dependent upon the diurnal heating of the lower strata of the air, since it reaches a maximum of intensity toward 1 o'clock in the afternoon.

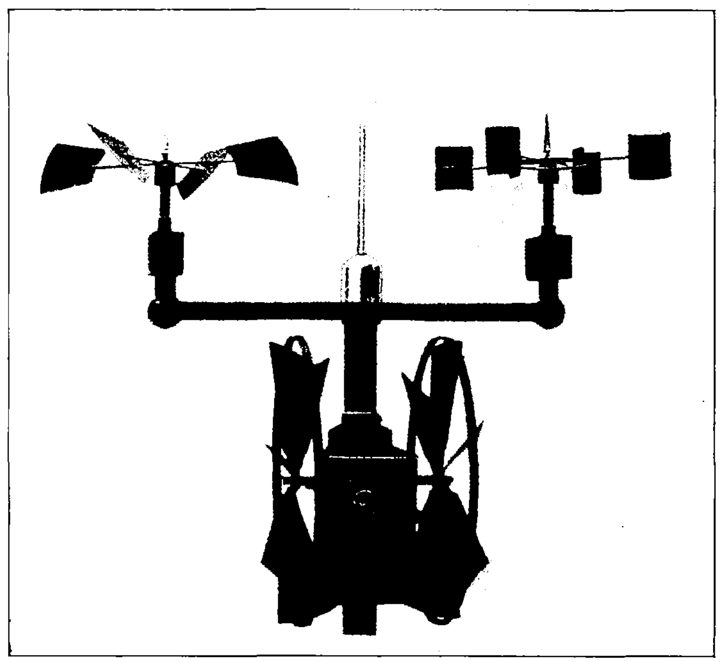

FIG. 2.—The universal anemometer of Dechevrens, which registers electrically the direction of the wind, the horizontal component of the wind velocity; the positive and negative vertical components separately.

But what is most remarkable and probably most unexpected is the variation of the descending component; the annual resultant is insignificant, but the behavior of the hourly variation is singular and will merit special attention in the general study which we have undertaken. The maximum of descending velocity occurs at noon, at the same time as the maximum of ascending velocity, and the ratio of this maximum to the minimum, which occurs at 4 a. m., is almost exactly 4. I will confine myself to pointing out the fact; I had previously observed the same thing in China.

The Dechevrens clino-anemometer, or inclined-blade anemometer, measuring the vertical currents, has been adopted in some observatories; it was even, in 1889, installed at the top of the Eiffel Tower, but under such bad conditions that the recorded observations could not be utilized. On account of the feebleness of the vertical component, which generally causes the wind to depart but little from a horizontal plane, any obstruction that modifies the regular action of the wind on the two sides of the anemometer produces errors which quickly attract the notice of the observer. In the other forms of anemometers, having great velocity of rotation, these errors, while probably greater, are less apparent; whence it happens that they have hitherto been neglected, though improperly so. It is this circumstance which led me to adopt the special arrangement of the Dechevrens universal anemometer. The only one in existence is at Jersey, because I have not made it sufficiently well known; but I wished first to have a certain number of years of observation to study and publish. This I hope to be able to do in the course of the present year, but meanwhile I wish to call the attention of meteorologists to an instrument destined to render service by the originality and genuine value of the observations which it will furnish.

THE IMPORTANCE OF A KNOWLEDGE OF VERTICAL WIND COMPONENTS.

By watching the motions of dust and light objects blown along by the wind at the earth's surface, we shall find that however strong or light the wind may be and however smooth or rough the surface of the ground, yet the dust while carried along horizontally is always blown upward by the wind; afterwards, in sheltered places, it settles by its own weight down to the ground. The gusts of wind are thus seen to have a strong upward component, and are followed for a few moments by a steady horizontal motion. After that comes a gentler wind that may have a downward component, but this is usually too gentle to be noticed, and very delicate apparatus would be needed to measure it. It is only in the rear of large obstacles that we sometimes find heavy downward gusts. Undoubtedly the volumes of the ascending and descending air must be the same, and if we could measure the vertical components at some point high above the earth's surface we should undoubtedly be able to prove this equality, but at any point near the earth's surface we can not possibly do so, and this because of two reasons. The earth's surface is a rigid lower boundary for the atmosphere; whatever air strikes against it must thereby have its direction and velocity changed, and this mechanical influence of the boundary must extend to a considerable distance upward. The rapid descent of a stream of air toward the ground begins to be appreciably checked before it reaches the latter, and is then at once deflected into a horizontal movement. This movement may be much more rapid than the vertical descent, because the latter produces a special horizontal gradient of pressure forcing the air outward while the rest of the descending air is steadily pressing downward at the center. This is the origin of the violent upward gust in the front of every advancing and rolling mass of air. The front of every cold wave, of every thunderstorm gust, of every dusty gust in the streets of a city presents these upward gusts in the front of an advancing mass of air, which is in general pushed onward by a mass that is descending slowly to the ground or flowing toward the Tropics. Now, all gusts, as has been shown by Professor Marvin, are sources of insidious errors in the records of any whirling anemometer whose arms have a large moment of inertia; these invariably record too large a movement. The ordinary gusts of wind peculiar to the climate of Washington City have an influence that has been determined by Professor Marvin by the use of special anemometers whose moments of inertia are exceeding small, an influence that amounts to a considerable per cent of the recorded velocity of the wind. (See Monthly Weather Review, February, 1900, p. 58, or Annual Report of the Chief Signal Officer, 1890.) This influence varies with the strength and duration of the gusts, and the correction for it should be determined for each locality, as it may depend very much on the building and on the method of mounting the anemometer. Marvin's small paper-cup anemometer was afterwards loaned to Professor Langley and used in his determinations of the gustiness of the wind.

Independent of all questions as to the method of construction and instrumental corrections of the Dechevrens or any other form of anemometer intended to measure vertical components, the fact that the descending motions are usually so feeble as compared with the ascending makes it evident that the above records obtained by Dechevrens on the island of Jersey and those obtained by others located anywhere near the ground are not giving us the desired relation between the ascending and descending motions of the free air. At Jersey the descending component is at midday only 4 per cent and at night-time about 1 per cent of the ascending. In Washington or other interior stations the descending velocities at night-time would show a very much higher average ratio, since the horizontal and asscending velocities frequently become inappreciable, while descending gusts still occur. In the case of foehn or chinook winds only the descending gusts are violent.

If the Dechevrens anemometer had no moment of inertia and could record the lightest winds and the heaviest gusts with the same accuracy, then the relations between his ascending, descending, and horizontal components would be valuable numerical expressions of the lower boundary conditions that must be introduced into the solution of the differential equations that occur in hydrodynamics. Accurate observations of this kind are needed for many localities, and the special conditions surrounding the island of Jersey makes that one of the most interesting spots. But we also need measurements of the three components at much higher elevations and in much freer air than is found so near the earth's surface. The observations of the altitude of a kite, the strain on its wire, the special curves in the sag of the wire, and the alternate rising and falling of the kite itself have long been recognized in a general popular way as revealing the presence of ascending and descending currents in the free air. In fact, the continuous records of tensions and altitudes and of the sway to the right and left, are sufficient to show that the oscillations of the upper winds on either side of a mean position are about equal, and that there is no such general discrepancy between ascending and descending currents, as is shown by Dechevrens in the table for the island of Jersey.

Langsdorf quotes a rule adopted by millwrights as the result of the experience of centuries; in accordance with it the plane of rotation of the windmill sails is inclined to the vertical at an angle of 15°. It is popularly said that the dangerous gusts blow downward, and that the plane of rotation must be tipped over so as to be normal to the gust, but it is likely that the play of the wind around the mill is an equally important factor. In great storms the masses of heavy air descend with a boom like that of rolling surf; so also they do in the lee of an obstacle shaped like Table Mountain at Cape Town, but these are special cases.—*C. Abbe.*

NOTE ON THE DECHEVRENS UNIVERSAL ANEMOMETER.

In 1894 the Weather Bureau installed at Washington one of the Dechevrens vertical movement anemometers, as made by Richard. The anemometer appears to be of practically the same construction as that shown in fig. 2. The mill for measuring vertical movement was the only part installed, and this was placed at the tiptop of a tall slender support rising about 40 feet above the floor of the roof platform on the top of the Weather Bureau building. Even under these conditions of exposure the results were entirely unsatisfactory from a meteorological point of view, as the record showed a decided upward movement of the air, especially when the horizontal movement was considerable and from the north and west. This result was due altogether to the upward flow of the wind in striking and passing *over* the Weather Bureau building.

It was not considered feasible to provide a better exposure on a more lofty support, and after several months the anemometer was removed.

It is highly gratifying to see that the question of exposure has been so carefully considered by Rev. Marc Dechevrens, and the only doubt in my mind is whether the anemometer on the tower is elevated sufficiently above the top platform of the tower to be entirely free of eddies and disturbances caused by its proximity. The meagre knowledge of these conditions afforded by an examination of the photographic illustrations of the tower does not enable us to form satisfactory conclusions. A proper exposure of the anemometer is, however, only one of the several serious difficulties connected with the problem of measuring the vertical motion of the air.

A similar difficulty is found in the installation of the anemometer, so that it shall be absolutely neutral in a strictly horizontal wind. It is obvious that if the axis of the anemometer is slightly inclined from the vertical, then a wind moving horizontally will have a small component of motion parallel to the axis of the mill, and will presumably cause it to rotate. We have, therefore, in this defect of installation, a source of error which it seems to the writer it is very difficult to avoid. To be properly exposed, the instrument must be on the summit of a relatively slender support. To make the axis strictly vertical under these conditions is by no means an easy matter. We apprehend that the flexure or yielding of the support under wind pressure, especially with great horizontal motion, may not be negligible.

In the case of the Dechevrens universal anemometer, it is not sufficient to secure perfect verticality for the axis of the vertical component mill only. The axis of the apparatus which orients both anemometers must also be made strictly vertical, and furthermore must possess such an adequate degree of rigidity that flexures and temporary displacements from the vertical are not possible.

Even supposing, however, that a sufficient approximation to verticality has been attained and maintained, there is still another source of instrumental error that must be corrected numerically or eliminated mechanically before a true interpretation of the records is possible. This has reference to the symmetry of the four vanes and arms constituting the vertical movement mill. It is easy to see that if the complex system of pressures acting on this mill when it is subjected to horizontal wind are not in perfect equilibrium, a continuous or at least partial rotation will be set up, and will be attributed to a vertical motion of the air; the mill will turn to a position where the wind will tend to hold it and prevent rotation, even should it be acted upon by a real vertical component of motion of feeble influence.

Finally, the vertical component of motion is at best very small, and any anemometer to measure it should be very sensitive. The instrument of the Dechevrens pattern furnished to the Weather Bureau by Richard is decidedly less sensitive than the anemometers commonly supplied to measure horizontal movement. The writer is of the opinion that a much more sensitive type of instrument is required.

It is hoped that the full report of the observations on the island of Jersey will show how and to what extent the several difficulties and sources of error discussed above have been overcome and eliminated.

So far as known to the writer the vertical movement anemometer has never been subjected to actual experimental calibration. The interpretations of its indications are based entirely upon a theoretical computation of the movement of wind per revolution of the mill depending upon the pitch of the blades. Until such an assumption is shown to be justified by experimental data the interpretation of the observations must be somewhat uncertain.—*C. F. Marvin.*

A STUDY OF SOME ERRORS OF KITE METEOROGRAPHS AND OBSERVATIONS ON MOUNTAINS.

By HENRY HELM CLAYTON, Meteorologist of the Blue Hill Meteorological Observatory, dated April 3, 1904.

In order to get the best results from the records obtained in the free air by means of kites at Blue Hill, the errors to which the records are subject have been carefully studied. Since the methods and conclusions derived from this study may be of service to others undertaking such investigations, it seems well to publish the results promptly.

It appears to be a common belief that errors may be eliminated from any set of measurements by taking hundreds of observations and averaging them. But this only eliminates the accidental plus and minus errors of equal frequency and value. Errors in one direction, or constant errors, are the rule and not the exception. Accordingly, in reducing the kite records obtained at Blue Hill great effort has been made to eliminate these constant errors. The reduction of the records has, therefore, been a much slower and more tedious undertaking than would otherwise have been the case.

Six possible sources of constant error have been recognized as influencing the records. These are (1) instrumental errors, (2) errors in exposure of instruments when comparing with standards, (3) errors in reading from meteorograms, (4) errors due to the local environment, (5) errors due to the observations being limited to certain weather conditions, (6) errors in determining vertical gradients, due to simultaneous changes in weather conditions at various heights while the instrument is moving vertically from point to point in the atmosphere.

(1)—INSTRUMENTAL ERRORS.

The meteorograph used at Blue Hill was made by Mr. S. P. Fergusson, and has been carefully calibrated, as described in the Annals of the Harvard College Astronomical Observatory, vol. 43, part 3. But in the rough usage attending kiteflying the instrument may be injured, and it is necessary to examine instrument and records after each flight for indications of such displacement of parts as would give rise to error. Changes in the positions of the recording pens in relation to the lines of reference on the charts are determined by comparing the meteorograph with standard instruments in a standard shelter before and after each flight. The differences are applied as corrections to reduce the readings of the meteorograph to those of the standard instruments. The errors of range are more difficult to detect than simple displacements of the zero of the scale, but are very important, because the instrument is likely to encounter much lower temperatures and humidities in the upper air than are encountered at the ground, and, if the corrections found at the ground do not remain the same aloft, where the readings are much lower, considerable error may result. The temperature and humidity usually change considerably between successive kite flights, so that this gives an opportunity for roughly testing the range each time. If any change is suspected, the instrument is recalibrated. Errors due to the flexure of parts of the instrument under various strains are also carefully sought for; such errors may be large unless the instrument is carefully built. In certain cases corrections are needed for the sluggishness of the instruments, but as there is risk of additional error in applying these corrections it has not been attempted at Blue Hill, except in the case of the humidity when the correction was apparent. On the other hand, an attempt has been made to avoid this error